REMOVABLE FACE PLATE COMPRESSED DIGITAL MUSIC PLAYER

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TECHNICAL FIELD OF THE INVENTION

The technical field of this invention is compressed digital music players.

BACKGROUND OF THE INVENTION

Music and entertainment systems for the consumer have undergone enormous improvements in the last few decades. Equipment size as decreased from bulky and heavy to palm-size and extremely light weight. Media for storage in the form of cassette tapes and then compact discs has allowed an

increasingly larger amount of songs and voice to be carried easily from place to place. Flash memory card storage and compressed audio formats have allowed additional breakthroughs. The consumer appetite for even more personal access to large volumes of audio clearly has invited increased use of hard disc storage and presented a need for Internet access even in inexpensive systems.

In recent years the specifications of the motion picture experts group (MPEG) have exerted a strong influence on all new design activity. The MPEG specifications relate to both picture and sound. MP3 audio, which is a specific MPEG layer 3 audio format, is becoming enormously popular as the audio format of choice for the future. Available MP3 players have already been introduced illustrating that the healthy appetite of many consumers can be satisfied with technology available, but the price may still be prohibitive.

In consumer electronics, however, additional product cost reduction is always needed. Lower costs translate to higher demand and more customers. New techniques for reducing cost will always be sought.

SUMMARY OF THE INVENTION

This invention comprises a two part removable face plate audio system in which all of the processing power is allocated to a small, lightweight satellite part that is the face unit. Mass storage, amplification, and wired power for recharging batteries in the face unit is provided by the other part, the base. It is contemplated that the base unit would be mounted in the dash of an automobile. As an alternative, the base unit could also be replicated for home use. In this

alternative the base unit would run from a 120 volt AC source instead of 12 volt DC. The face unit could contain flash memory, perhaps a range of 64 to 128 Megabytes, making it capable of carrying music normally stored on two or more compact discs (CDS).

An important aspect of this system is the capability of quickly transferring music to and from the face unit via an AT parallel interface for example. A base unit designed for home use might also contain a CD player with an on screen display and a wired mechanism, examples being local area network LAN or digital subscriber line DSL. Such a wired mechanism would allow for downloading music directly from the Internet.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of this invention are illustrated in the drawings, in which:

Figure 1 illustrates the block diagram of a combination of a removable face plate MP3 player and a base unit of this invention;

Figure 2 illustrates the block diagram of the codec function within the MP3 player recorder of this invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

This invention comprises a two part removable face plate audio system in which all of the processing power is allocated to a small, lightweight satellite part called the face unit. Mass storage, amplification, and wired power for recharging a battery in the face unit are provided by the other part, the base.

The MP3 face player provides a modular system for transporting MP3 encoded music from the PC to the car. The MP3 face player is small, light weight, and can be operated independent of the car base. The alternative to transferring the music to the car in this way is using some form of media like CDS. This requires a CD writer and is more time consuming than simply downloading to the face unit.

The MP3 face player also provides a means of transferring the music from the car base to another user stereo. If, for example, a consumer is attending a party, and someone would like to listen to some music the consumer has in his car, he can simply access the music at the face unit, remove the face unit and attach it to the party stereo for play. The economic impact of the removable face unit is that a separate portable player is not required. The same face unit can also be used as a portable player.

As another alternate design feature, an Internet connection like this could be implemented in the face player itself linking the product to a proprietary website. In the preferred embodiment the car unit might also contain a CD player capable of extracting MP3 music and storing to its own hard drive.

There are a number of reasons why such a model might be more interesting than a PC tethered model. Assume that the user is away from home, a situation that is a likely scenario in their car. A modem link might enable them to download any song from an Internet source, assuming that this music is not already stored in their car system. A possible mechanism for doing this would make use of the tuner keys to enter artist

name and title and the liquid crystal display LCD to provide feedback.

In Figure 1, the LCD/keypad I/O device 101 contains an LCD driver, an LCD, and push buttons mounted on the face plate to allow for user access and control. The digital signal processor 102 via path 122 accepts these user commands entered with the keyboard push buttons to a set of input registers holding the requested input. As an alternate, an LCD I/O interface chip or an ASIC integrated version could be used.

The LCD display is preferably alphanumeric and, along with the keyboard push buttons, enables the user to select specific songs or groups of songs for play sequencing. The controls are those common to commercially available MP3 players and FM car stereo systems.

The digital signal processor 102 in Figure 1 is capable of decoding MP3 format information or information from other audio coder-decoders (codecs) in real time. A typical example would be a DSP such as the Texas Instruments TMS320C54. This DSP performs multiple functions including: MP3 decode; user I/O; LCD update; disk I/O; and infrared (IR) communications.

Infrared transmission interface (IRDA) 103 performs communications with other systems 113. These other systems 113 could be other face units, a face unit and a computer, or the face unit of another base unit. Data transmitted over the IR interface may be encoded or decoded. For encoded applications, MP3 data is transmitted between the face unit and other system 113 for local decode or storage. For decoded applications, the face unit may transmit typically 1.5 Megabits of per second digital stereo audio to another system for immediate play through a local audio coder-decoder

broadcast. The IR interface ideally is IRDA 2.0 compliant enabling up to 4.0 Megabits communications between other face units or computers with IRDA compliant interfaces. The range on transmission of data is dependent on the data rate being used for transmission. Higher speed data rates will require closer ranges, i.e. 3 feet. Among several possibilities for PC interfacing might be universal serial bus USB, IEEE 1394, or another high-speed serial interface.

Flash memory 104 is nonvolatile and may have storage capacity of 32 or 64 Megabytes. An optional smart media or compact flash slot could be incorporated into the face unit for memory upgrade. The face unit reserves a portion of flash memory 104 for storing programs to accomplish face unit operating system boot and decoder software loading.

Rechargeable battery pack 105 is preferably of nickel-metal hydride composition. Rechargeable battery pack 105 automatically recharges via power converters 112 when connected to the base. There should be enough on board battery power within rechargeable battery pack 105 to provide several hours of un-tethered playback by the face unit.

Audio codec 106 is capable of converting compact disc quality digital stereo data into analog audio and contains enough amplification to drive an 8-ohm headset earphone 107. Headset earphone 107 is preferably connectable to the face unit via a standard audio plug. The resulting signal 121 produced by audio codec 106 may also serve as input signal for pre-amplifier 108 which drives the base unit power amplifier 109 and the speaker system 117. Pre-amplifier 108 receives volume setting information from the face unit either digitally via the 16-bit AT interfaces 114 and 115 or through a

separately dedicated analog signal. This same signal can be used to control power to the face unit. Audio codec 106 is read from and written to directly by digital signal processor 102. Audio codec 106 is optionally capable of converting analog audio signal from microphone input 110 via pre-amplifier 120 into to digital data in the same fashion. This would permit digital recording of analog music received by tuner 118.

This makes the face unit capable of taking dictation or recording specific analog songs from a radio broadcast in real time. If analog song recording is implemented, the system could immediately store the digitized, uncompressed audio samples to base unit disk 111. Digital signal processor 102 may convert the music to MP3 format later for future retrieval. The digitized, uncompressed audio samples in this case could be bi-directionally transferred between the face unit and the base.

The tuner 118 of the base contains a standard FM/AM tuner with RF inputs 116 from an antenna. Tuner 118 produces analog audio preamp signals supplied to pre-amplifier 108. The user tunes the desired station via the face unit using LCD/keypad I/O device 101 and station selection is communicated to the tuner either through the 16-bit AT interfaces 114 and 115 or some alternative two wire interface such as IIC. Analog audio from tuner 118 is optionally coupled to audio coder-decoder 106 via analog connection 119.

Tuner 118 may optionally be capable of receiving compressed digital audio data. This data would then transmitted to the face unit through 16-bit AT interfaces 114 and 115. The face unit digital signal processor 102 would

then decode the compressed data and play back the digital audio data through audio codec 106 to pre-amplifier 108.

Within the base, the disc drive 111 is preferably a standard small form factor drive operating in PIO mode 4 (DMA unsupported). The disc drive 111 is preferably capable of several gigabytes of storage. The interface between disc drive 111 and the face unit could be by 16-bit AT interfaces 114 and 115. Alternatively, the interface might be USB or IEEE 1394 and the face unit might have only this I/O interface. In this case the face unit may connect with a PC using this same interface that is used to interface to the drive at the base. The power converters 112 draw from the car onboard 12 volt DC source and produces the various voltages, such as 3.3 volts, 2.5 volts, 5 volts DC, as the face unit may require.

Referring to Figure 2, first note the upper portion of which illustrates a encoder block diagram for recorder applications. In the record mode, the MP3 device uses the encoder path, with audio input to be recorded entering at node 200. Block 201 is the analog audio data interface which amplifies the input signal and passes it to the analog to digital converter 202 for conversion to digital. After this conversion algorithms may be applied such as quantizing or removal of redundant data via run-length encoding in compression block 203.

The compression block 203 may or may not be MP3 encoding. It may be partial encoding because MP3 encoding requires significantly more processing than MP3 decoding. There are other encoding schemes that might be used in the compression block which are better adapted to speech compression such as

G.711. It is also possible for the device to simply store the raw digital data during recording and dedicate the power of digital signal processor 102 to perform MP3 decode enabling the consumer to simultaneously listen to MP3 music while recording a program off the radio. Since MP3 or other compression methods which could be used are implemented in software, the desired compression can be performed when the user is listening to a tuned radio station or when the face unit is not actively used. The system would not necessarily perform run length encoding or quantization as a predecessor to MP3 encoding. It might use one of these techniques to store the data initially and subsequently, reload, decode, and recompress the data using MP3 techniques.

The lower portion of Figure 2 illustrates a decoder block diagram for player applications. In the play mode, the MP3 device uses this decoder path, with digital audio input to be decoded entering at node 210. This digital audio input would typically be from FLASH memory 104 or from the base disc drive 111 via 16-bit AT interfaces 114 and 115. Block 211 is the digital interface which receives the input digital signal and passes it to the decompression block 212 for conversion to full digital format with all data bits, even redundant ones present. After this decompression step is complete, the full digital audio is sent to digital to analog converter (DAC) block 213 for digital to analog conversion. The analog data at this point is passed to the amplification block 214 and then the power amplifier stage 215 to generate sufficient drive for the speakers.

The present invention separates the face plate and the base portions of an MP3 player/recorder unit into two

autonomous parts. This allows the user to have a totally portable MP3 unit with powerful application features at nominal cost. The inventor believes that this provides opportunities to develop products with otherwise unavailable market applications. This additional leverage give manufactures and marketers new tools to hold costs in line while providing the best performing products possible.